Mars Analog Rio Tinto Experiment(MARTE): An experimental demonstration of key technologies for searching for life on Mars

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The discovery of near surface ground ice by the Mars Odyssey mission and the abundant evidence for recent Gulley features observed by the Mars Global Surveyor mission support longstanding theoretical arguments for subsurface liquid water on Mars. Thus, implementing the Mars program goal to search for life points to drilling on Mars to reach liquid water, collecting samples and analyzing them with instrumentation to detect *in situ* organisms and biomarker compounds. Searching for life in the subsurface of Mars will require drilling, sample extraction and handling, and new technologies to find and identify biomarker compounds and search for living organisms.

MARTE (Mars Analog Rio Tinto Experiment) is a field experiment to search for evidence of a subsurface biosphere analogous to one that could be found on Mars. MARTE is developing drilling, sample handling, and instrument technologies relevant to searching for a Martian biosphere, and demonstrating them in a field test at a site with a Mars-analog subsurface biosphere. The mission simulation will employ a drilling system developed by Honeybee robotics for future use on Mars that produces 25 cm core segments at 2.5 cm diameter while operating on low power without the use of drilling fluids. An automated Core and Sample Handling facility will extract cores from the drill and pass them to a suite of instruments on the surface. Cores are examined by remote sensing instruments including a panoramic context imager, microscopic imager, and a visible-near infrared hyperspectral imager. A sterile swab from each core is examined using ATP luminometry for a quick-look indication of the presence of living organisms. Logging instruments deployed in the borehole include a camera, magnetic susceptibility meter, and raman spectrometer. A science team located at remote operations centers analyzes the data from the logging instruments and selects core locations to sample with a life detection instrument located onboard the lander. Once subsample locations are chosen, a subsection of core is cut out, crushed, and then placed into the SOLID prototype life detection instrument for further processing. The SOLID is a portable automated instrument that uses DNA and protein microarray technology to detect microorganisms as well as their metabolic products. The instrument is capable of sensing many kinds of biochemical compounds (nucleic acids, proteins, polysaccharides, etc) using microarrays printed with DNA, antibodies or any other protein or molecule able to recognize and bind specifically to them. A Mars drilling mission simulation will be performed in June 2005 that includes interpretation of drill mission results by a remote science team in a blind test. This simulated drill mission is augmented by additional "ground truth" utilizing more conventional methods for drilling, sample handling, and laboratory analysis to explore for a subsurface biosphere at the field site. The MARTE project achieves exploration of an uncharacterized underground ecosystem of key relevance to Astrobiology and the search for life on Mars, while also developing and demonstrating technology needed in the next phase of Mars exploration.

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